



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/828,592	04/21/2004	Betty Shu Mercer	TI 36275	5550

23494 7590 02/23/2006

TEXAS INSTRUMENTS INCORPORATED
P O BOX 655474, M/S 3999
DALLAS, TX 75265

EXAMINER

FULK, STEVEN J

ART UNIT	PAPER NUMBER
----------	--------------

2891

DATE MAILED: 02/23/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/828,592

Applicant(s)

MERCER ET AL.

Examiner

Steven J. Fulk

Art Unit

2891

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 28 November 2005.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) 11-15 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☐ Claim(s) 1-10 and 16-20 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 21 April 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☒ Other: Non-patent Literature.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1-6, 10, 16 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Datta '133 in view of Ashby et al. '238.

- a. Regarding claims 1-6 and 10, Datta teaches a method of manufacturing an interconnect for an integrated circuit comprising forming a surface conductive lead (fig. 6, 34) in an opening formed within a protective overcoat (18/20) and over a barrier layer (26) and seed layer (28), wherein the protective overcoat comprises layers of silicon nitride and polyimide or silicon oxide (col. 2, lines 57-65), the barrier layer is a tungsten titanium (TiW) barrier with a thickness of about 200 nm (col. 4, lines 1-3), and the seed layer is copper (col. 4, lines 8-15). The reference teaches subjecting the seed layer (col. 5, lines 58-63) and barrier layer (col. 6, lines 43-49) to an etch process to remove the portions extending beyond the surface conductive lead.

Datta does not explicitly teach the use of a dry etch chemistry including carbon tetrafluoride and nitrous oxide, oxygen or chlorine to

remove the portions of the TiW barrier layer. Ashby et al. teaches the use of carbon tetrafluoride in combination with nitrous oxide, oxygen or chlorine to etch the transition metal alloy of tungsten and titanium in the fabrication of integrated circuits (col. 4, lines 58-65; col. 6, lines 29-47).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use the dry etch gases of Ashby et al. to etch the TiW barrier layer of Datta because the combination of carbon tetrafluoride and nitrous oxide, oxygen or chlorine was a conventional dry etch chemistry for the removal of tungsten and titanium alloy barrier layers.

b. Regarding claims 16 and 20, Datta teaches all of the elements disclosed above in the discussion in view of Ashby et al., and further teaches fabricating several metallization layers of a microelectronic device in an integrated circuit (col. 1, lines 8-13, 29-35; col. 2, lines 47-54). The reference does not explicitly teach forming transistor devices on the semiconductor substrate and interconnecting the transistors with one or more of the metallization layers.

However, it would have been obvious to one of ordinary skill in the art at the time the invention was made for the microelectronic device being connected by metallization layers of Datta to include transistor devices, as transistors were an integral part of a microelectronic device.

3. Claims 7, 8, 17 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Datta '133 in view of Ashby et al. '238 as described above, and further in view of Backus '124.

Datta in view of Ashby et al. teaches all of the elements of the claims as discussed above including a method of wet etching the copper seed layer to remove the portions extending beyond the surface conductive lead (col. 6, lines 4-11). Datta does not explicitly teach using a wet etch of hydrogen peroxide and sulfuric acid to remove the seed layer.

Backus teaches a method of etching copper to fabricated printed circuits using a etch chemistry including hydrogen peroxide and sulfuric acid (col. 2, lines 43-51).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use the etch chemistry of Backus to etch the copper seed layer of Datta because hydrogen peroxide and sulfuric acid was a conventional solution for etching copper.

4. Claims 9 and 19 are is rejected under 35 U.S.C. 103(a) as being unpatentable over Datta '133 in view of Ashby et al. '238 as described above, and further in view of Homma et al. '752.

Datta teaches a method of forming a surface conductive lead, but does not teach the lead having a width ranging from about 3 μm to about 200 μm . Homma et al. teaches a method of forming a surface conductive lead having a width of about 100 μm (col. 5, lines 51-57).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to form the surface conductive lead of Datta with a width as specified by Homma et al. because this was a conventional width for bond pads being used in a flip-chip or wire bonding process.

Response to Arguments

5. Applicant's arguments filed November 28, 2005 have been fully considered but they are not persuasive.

a. Regarding the rejection of claims 1-6, 10, 16 and 20 under 35 U.S.C. § 103(a), Applicant argues that neither Datta '133 nor Ashby '238 alone teach the element of subjecting a portion of a barrier layer extending beyond a surface of a surface conductive lead to a dry etch to remove the portion, the dry etch being selective to the barrier layer. It is the Examiner's position that the combination of Datta '133 in view of Ashby '238 teach all the elements as claimed. One cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

b. Regarding the rejection of claims 1-6, 10, 16 and 20 under 35 U.S.C. § 103(a), Applicant argues that the examiner's conclusion of obviousness is based upon improper hindsight reasoning. It must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the applicant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971). In this case, the teaching that a dry etch chemistry of carbon tetrafluoride and oxygen is selective to

titanium-tungsten is well known in the art. It is also well known in the art that anisotropic dry etching overcomes the problem of undercutting of layers that occurs in an isotropic wet etch process.

c. Regarding the rejection of claims 7, 8, 17 and 18 under 35 U.S.C. § 103(a), Applicant argues that Backus '124 alone fails to teach the element of subjecting a portion of a barrier layer extending beyond a surface of a surface conductive lead to a dry etch to remove the portion, the dry etch being selective to the barrier layer. It is the Examiner's position that the combination of Datta '133 in view of Ashby '238, and further in view of Backus '124, teach all the elements as claimed. One cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

d. Regarding the rejection of claims 9 and 19 under 35 U.S.C. § 103(a), Applicant argues that Homma '752 alone fails to teach the element of subjecting a portion of a barrier layer extending beyond a surface of a surface conductive lead to a dry etch to remove the portion, the dry etch being selective to the barrier layer. It is the Examiner's position that the combination of Datta '133 in view of Ashby '238, and further in view of Homma '752, teach all the elements as claimed. One cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208

USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

Conclusion

6. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

a. Wolf (NPL reference "U") teaches it is well known that an ideal etch process has zero bias (the difference in lateral dimension between the etched image and the mask image), meaning a completely anisotropic etch is most ideal (p. 522). Wolf further teaches it is well known that dry etching is anisotropic, and therefore has an advantage in dimensional control over wet etching (p. 551-552).

b. Crank '974 teaches a method for manufacturing an interconnect for an IC comprising a surface conductive lead over a barrier layer, wherein the barrier layer is selectively etched by carbon tetrafluoride (fig. 2f, barrier layer 20 is removed while underlying oxide layer 14 remains intact).

c. Fan et al. '771 teaches a method for manufacturing an interconnect for an IC comprising a surface conductive lead over a barrier layer, and describes the dry (RIE) etching of the barrier layer as standard procedure (¶59).

d. Lin '542 teaches it is well known to selectively etch titanium-tungsten using carbon tetrafluoride and oxygen (col. 2, lines 36-59).

e. Black et al. '557 teaches a method of etching copper using sulfuric acid and hydrogen peroxide (col. 2, lines 35-38 & 57-58), and recites that this

combination is advantageous because the solution remains clear and clean, and is easily regenerated to optimum etching strength (col. 1, lines 15-21).

f. Nakagawa '389 teaches a method of etching copper using sulfuric acid and hydrogen peroxide, and recites that this combination is advantageous because it has a fast etching speed, does not oxidize the copper surface, and is easily handled (col. 1, lines 20-27 & 66-67).

7. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Steven J. Fulk whose telephone number is (571) 272-8323. The examiner can normally be reached on Monday through Friday, 9:00am to 5:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bill Baumeister can be reached on (571) 272-1722. The fax

Art Unit: 2891

phone number for the organization where this application or proceeding is assigned is 571-273-8300.

9. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Steven J. Fulk
Patent Examiner
Art Unit 2891

February 16, 2006



BRADLEY K. SMITH
PRIMARY EXAMINER